

# Development of a Radiation Hardened CZT Sensor Array and 1U CubeSat Flight Test (>TRL 6), Phase I

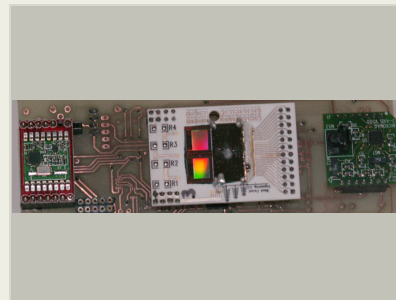
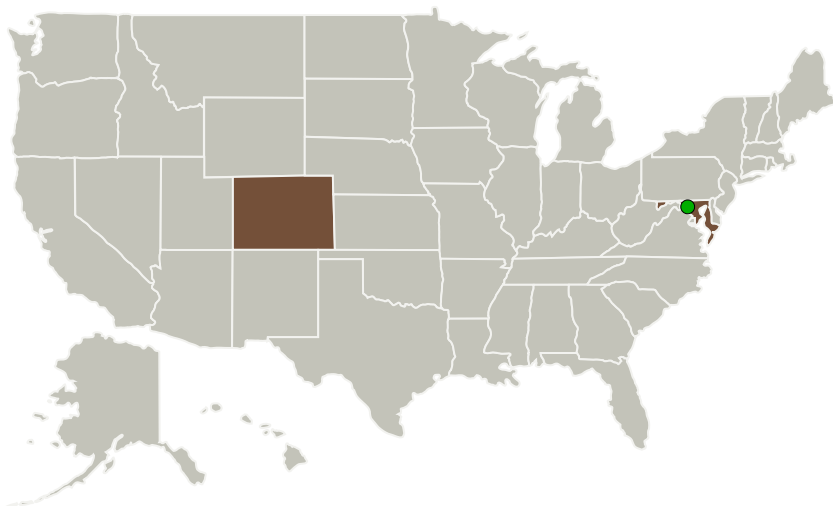
Completed Technology Project (2014 - 2014)



## Project Introduction

Instruments employing X-ray, gamma ray and particle detection are utilized in different sectors from medicine to industry and from basic to applied science. The solid-state detector array with detection ASIC is the primary technology of space-based high-energy astronomy missions that are managed by NASA in partnership with the international community<sup>1,2</sup>. A readout integrated circuitry (ROIC) specifically designed for photon resolving X-ray detection has been developed by Black Forest Engineering on prior NASA SBIR funding<sup>3</sup>. The BFE322 ROIC, bump bonded to a CdZnTe (CZT) 16x32 detector array, demonstrated single photon sensitivity, accurate X-ray energy determination, X-ray event time stamping, and low power dissipation ( $< 10 \mu\text{W}$  per pixel) at ambient temperature operation; this represents a significant advancement in detection capability. The proposed Phase I improves ROIC performance by using low  $1/f$  noise 250 nm CMOS, in-pixel amplifier tuning to match detector capacitance and rad-hard-by-design (RHBD) to provide  $>500 \text{ kRad}$  radiation tolerance. The Phase I design will be a  $32 \times 32$  pixel format with  $600 \mu\text{m}$  pixel pitch compatible with CZT and silicon detector arrays. The ROIC will be fabricated and hybridized to CZT on Phase II and demonstrated using a PocketQube or CubeSat mini-satellite test flight to establish a  $\text{TRL} > 6$ .

## Primary U.S. Work Locations and Key Partners



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## Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

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Organizations Performing Work	Role	Type	Location
Black Forest Engineering, LLC	Lead Organization	Industry	Colorado Springs, Colorado
 Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Colorado	Maryland

## Project Transitions

 **June 2014:** Project Start

 **December 2014:** Closed out

**Closeout Summary:** Development of a Radiation Hardened CZT Sensor Array and 1U CubeSat Flight Test (>TRL 6), Phase I Project Image

**Closeout Documentation:**

- Final Summary Chart Image(<https://techport.nasa.gov/file/137585>)

## Images



**Briefing Chart Image**

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(<https://techport.nasa.gov/image/133050>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Black Forest Engineering, LLC

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

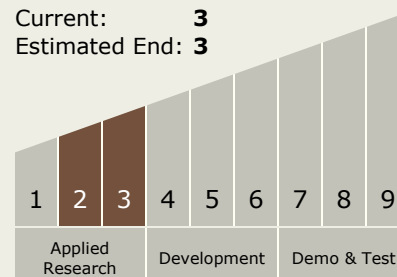
Carlos Torrez

**Principal Investigator:**

Stephen Gaalema

## Technology Maturity (TRL)

Start: **2**  
Current: **3**  
Estimated End: **3**



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## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.1 Detectors and Focal Planes

## Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System